North Bay Case Study 2015

RETURN TO CASE STUDIES

When the city of North Bay, Ontario, explored the use of interlocking concrete pavers for its heavily trafficked downtown city center in the early 1980s, officials of this city of 54,000 wanted to know they'd be getting the most for their money. Not only did the resulting installation meet aesthetic and functional goals, it has since become a model of low-maintenance cost savings that has proved durable well beyond its projected lifespan of 20 years.

At the time of its completion in 1983, the $3 million, 150,000 sf (13,900 m2) Main Street project, which included roadway and sidewalks constructed on the full width of the road allowance, was hailed for its aesthetic contribution to a revitalized downtown business and retail district. When surveyed eight and 16 years later, the pavement was found to be performing exceptionally well under high traffic and extreme weather conditions, with little evidence of distress, despite minimal maintenance needed. In fact, after 12 years, a city official confirmed that there had been no maintenance at all. In addition, a 1999 life cycle cost analysis that compared the concrete paver installation with a local control section of hot-mix asphalt pavement found a difference of

LIFE CYCLE COST SUMMARY
TOTAL PRESENT WORTH OF COSTS
(Calculations based on 40-year analysis period and 4 percent discount rate)

Interlocking Concrete Pavement Costs			Asphalt Pavement Costs		
Initial $/ lane-km	Maintanance $/ lane-km	Total $/ lane-km	Initial $/ lane-km	Maintanance $/ lane-km	Total $/ lane-km
159,465	**9,072**	**168,537**	**92,256**	**84,861**	**179,117**

Thirty-two years later, the installation is still perform- ing, though finally ready for replacement, says Adam Lacombe, P. Eng, North Bay senior capital program engineer. The city is budgeting for a paver replacement to begin in 2017 or 2018. “Main Street has always been the centerpiece of the city, and the [pavers] set it off,”he says. “We are [considering] replacing them for their aesthetic quality and lifespan.”

> ““Main Street has always been the centerpiece of the city, and the [pavers] set it off.””
>
> **— ADAM LACOMBE, P. ENG, NORTH BAY SENIOR CAPITAL PROGRAM ENGINEER**

EXTREME APPLICATIONS

The Main Street project was conceived at a time when the city of North Bay was planning to update its central business district with a more people-friendly scale and unified appearance. As part of the transformation, approximately 50 percent of the on-street parking was recommended for removal. In its place, designers envisioned wider sidewalks, boulevard areas and the addition of trees and planting areas, new benches, underground wiring and new streetlights.

Aiming to attract shoppers to a refreshed retail destination at a time when

aesthetic identity for the district. But another major goal was to find a pavement that could handle an expected traffic volume of 8,000 vehicles per day (5 percent delivery trucks and buses), as well as snow removal and harsh weather conditions.

In North Bay, temperatures can range from −40 C in winter to 35 C in summer, and punishing freeze-thaw cycles occur throughout the winter months, with frost depths of up to 8 ft (2.4 m). The Main Street roadway would be subject to approximately 300 tons of salt annually, as well as the regular impact of the carbide steel blades used on snow-removing graders, slushers and plows.

At the time of the project's conception, interlocking concrete pavers were already in use in high-load, harsh-weather projects around the world, and were just beginning to gain wider interest for heavy-use projects in North America. Just one year before the North Bay Main Street pavement was installed, 610,000 sf (56,700 m2) of interlocking concrete pavement was used in what is now called the Pier IX Terminal, in Newport News, VA. This facility handles ground storage of coal, so the pavers are subject to high loads from coal storage piles and abrasive loads from steel-tracked bulldozers. This provided an example of durability in an industrial setting.

North Bay officials had some experience with concrete pavers, which had successfully performed in an area around city hall for five winters under de-icing salts. But that area was not subject to vehicular traffic, so additional evidence was sought to prove the mate- rial and its installation could withstand projected traffic load and environmental conditions long-term.

A seminar that brought in experts from Australia, England and the Neth-erlands demonstrated to North Bay stakeholders how pavers had performed successfully under extreme loads and weather conditions in container ports, airports and roadways. Presenters offered compelling evidence that, when

BEST PRACTICES DEFINED

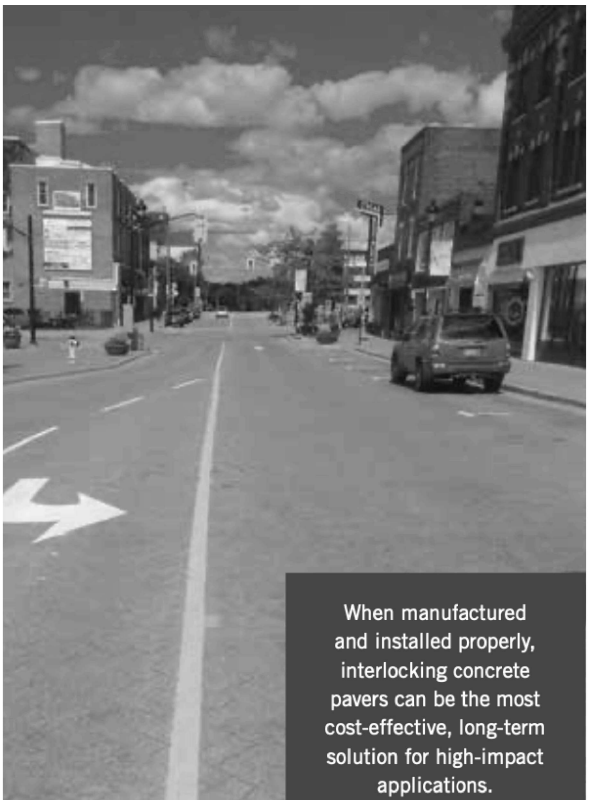
The manufacturers, designers, engineers and installers involved in the Main Street installation set their sights on creating a state-of-the-art model showcase for what was recognized as a high-profile project. The pavers were manufactured to resist abrasion and freeze-thaw conditions, meet compressive strength and absorption standards, and were subject to a salt immersion test. Installation included a compacted subbase and base, edge restraints in the form of cast-in-place concrete curbs, concrete collars around utility structures such as manholes to offer a stationary restraint for the pavers, a herringbone pattern to provide the greatest degree of interlock (except in the crosswalks, which use a running bond pattern), and a slight crown in the roadway to allow for natural settling and drainage after construction. Subdrains were utilized in some locations and surface water was designed to flow to catch basins and storm sewers.

During construction, installers per- formed regular density checks of the base with a nuclear density gauge to achieve the specified level of compaction that is critical to long-term performance. Nearing the end of installation, a plate compactor was used to force bedding sand into the joints and to facilitate the process of paver inter- lock, which in turn enables the transfer of vehicular load from paver to paver.

From today's perspective, the North Bay Main Street project helped define best practices for interlocking concrete pavement manufacture and installation, some of which later became ASTM and CSA standards, including those for compressive strength, freeze-thaw durability and dimensional durability, and remain in use today.

TEST OF DURABILITY

At eight years post-construction, an engineering consultancy performed a detailed condition survey and non-destructive deflection testing of the Main Street pavement. The survey found that about 4 percent of the approximately 57,000 sf of pavement surveyed had depressions concentrated in an area that had been subject to improper repair of the base when reinstalled after utility repairs. Another section that showed spalling resulted from incomplete joint filling and subsequently pavers losing interlock. Aside from this, the report concluded that the pavements provided “excellent performance...surface deformation occurs in less than 1.5 percent of the pavement areas surveyed,”and that the pavers were in “very good to excellent condition.”



When manufactured and installed properly, interlocking concrete pavers can be the most cost-effective, long-term solution for high-impact applications.

Sixteen years after completion, in 1999, a geotechnical engineering consultant performed another condition survey that included a comparison with a local control section of asphalt pavement. It concluded that the inter- locking

condition indexes (PCI) for tested sections averaging 70 on a scale of 0 to 100 (with 100 showing no distress).

At 20 years, North Bay Public Works confirmed that the pavement was expected to be serviceable for another 15 to 20 years with only minimal maintenance anticipated.

A COST-EFFECTIVE OPTION

As part of the 1999 survey, a 40-year model was used for a life cycle cost analysis comparing the pavers and an asphalt street model that concluded rehabilitation of the pavers would be required at Year 21 in order to maintain a pavement PCI of 60. For the asphalt pavement, rehabilitation would correspond to years 18, 27 and 36 to maintain a PCI of 60.

At a 4 percent discount rate (corresponding to a secure investment of 6 percent and inflation of 2 percent), interlocking concrete pavements were shown to be more cost-effective than asphalt pavements. The study did not reflect costs to the public in downtime from routine maintenance and repairs. Interlocking concrete pavers can have a significant benefit in terms of reduction of these user delay costs because traffic can be restored very quickly after repair; also, less maintenance downtime is required over the pavement's lifespan.

At 20 years, North Bay Public Works confirmed that the pavement was expected to be serviceable for another 15 to 20 years with only minimal maintenance anticipated.

Since 1983, North Bay has continued using interlocking concrete pavers in public sidewalks, boulevards, its train station and lengthy promenades along its award-winning Lake Nipissing Waterfront Park. In 2010, it added a one-block section of pavers in a roadway that complements nearby Main Street and sets off a roadway island park. Likewise, cities across the United States and Canada have since chosen pavers for a variety of low- and high-impact projects, taking advantage of their endurance, aesthetic qualities and green attributes, more recently including permeable installations that aid in stormwater management.

The details of North Bay's Main Street pavement rehabilitation are still to be determined as the city works on a new land use and urban design plan, says Mr. Lacombe. A rough estimate for replacing the pavement, including design and construction, is currently $2.4

North Bay faces the same decisions as hundreds of cities across North America: how to replace an aging downtown roadway in a way that's economical in the short and long term, while taking into account aesthetic and environmental considerations, and the needs of stakeholders. The Main Street project offers strong evidence that interlocking concrete pavers are suitable for high-impact applica- tions, and can be the most cost-effective pavement solution when considering total cost of ownership over the long term.

PREVIOUS

Atlanta Resilient Green Infrastructure with PICP

PERMEABLE INTERLOCKING CONCRETE PAVEMENTS